| 9th Class 2021 | | |
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| Physics | Group-I | Paper-I |
| Time: 1.45 Hours | (Subjective Type) | Marks: 48 |

## (Part-I)

**2. Write short answers to any FIVE (5) questions: 10**

**(i) Define base units and derived units.**

**Ans** "The units that describe base quantities are called **base units.**"

Each base quantity has its SI unit.

"The units used to measure derived quantities are called **derived units.**"

Derived units are defined in terms of base units and are obtained by multiplying or dividing one or more base units with each other.

**(ii) Define positive and negative zero error of vernier callipers.**

**Ans** Zero error will be positive if zero line of vernier scale is on the right side of the zero of the main scale and will be negative if zero line of vernier scale is on the left side of zero of the main scale.

**(iii) Define prefixes and give two examples.**

**Ans** **Prefixes** are the words or letters added before SI units such as kilo, mega, giga and milli. For example:

1. $20{,}000\ g = \frac{20{,}000}{1{,}000}\ kg = 20\ kg$
2. $48{,}00{,}000 = 4{,}800 \times 10^3\ W = 4{,}800\ kW$

**(iv) Define velocity and write its formula.**

**Ans** The rate of displacement of a body is called its velocity.

$$\text{Velocity} = \frac{\text{Displacement}}{\text{time}}$$

$$v = \frac{S}{t}$$

**(v) Convert 50 Km $h^{-1}$ to $ms^{-1}$.**

**Ans**

$$1 \text{ km h}^{-1} = \frac{1000 \text{ m}}{60 \times 60 \text{ s}} = \frac{10}{36} \text{ ms}^{-1}$$

Thus multiply speed in km $h^{-1}$ by $\frac{10}{36}$ to get speed in $ms^{-1}$ *e.g.*,

$$50 \text{ kmh}^{-1} = 50 \times \frac{10}{36} \text{ ms}^{-1}$$

$$= 13.88 \text{ ms}^{-1}$$

**(vi) Define rest and motion.**

**Ans** A body is said to be at **rest**, if it does not change its position with respect to its surroundings.

Surroundings are the places in its neighbourhood where various objects are present. Similarly,

A body is said to be in **motion**, if it changes its position with respect to its surroundings.

**(vii) Why rolling friction is smaller than the sliding friction?**

**Ans** When the axle of a wheel is pushed, the force of friction between the wheel and the ground at the point of contact provides the reaction force. The reaction force acts at the contact points of the wheel in a direction opposite to the applied force. The wheel rolls without

rupturing the cold welds. That is why, wheel's rolling friction is extremely smaller than sliding friction.

**(viii) Define centripetal acceleration and write its formula.**

**Ans** Acceleration produced by the centripetal force.

Let a body of mass m moves with uniform speed v in a circle of radius r. The acceleration $a_c$ produced by the centripetal force $F_c$ is given by

Centripetal acceleration $a_c = \frac{v^2}{r}$

**3. Write short answers to any FIVE (5) questions: 10**

**(i) Differentiate between like and unlike parallel forces.**

**Ans** **Like parallel forces** are the forces that are parallel to each other and have the same direction.

**Unlike parallel forces** are the forces that are parallel but have directions opposite to each other.

**(ii) Define torque and write its mathematical equation.**

**Ans** The turning effect of a force is called **torque** or moment of the force.

The moment of the force or torque $\tau$ is determined by the product of force F and its moment arm L. Mathematically,

Torque $\tau = F \times L$

**(iii) What do you mean by centre of gravity?**

**Ans** A point where the whole weight of the body appears to act vertically downward is called centre of gravity of a body.

**(iv) What do you know about "G"? What is its value?**

**Ans** $$F = G\frac{m_1 m_2}{d^2}$$

Here G is the proportionality constant. It is called the universal constant of gravitation. Its value is same everywhere. In SI units, its value is $6.673 \times 10^{-11}\ Nm^2\ kg^{-2}$.

**(v) Define artificial satellite.**

**Ans** An object that revolves around a planet is called a satellite. The moon revolves around the Earth, so moon is a natural satellite of the Earth. Scientists have sent many objects into space. Some of these objects revolve around the Earth. These are called artificial satellites. Most of the artificial satellites, orbiting around the Earth, are used for communication purposes.

**(vi) Define orbital velocity and write its formula.**

**Ans** **Orbital Velocity:**

The critical velocity of a satellite in order to keep on moving around the Earth at a specific height.

Orbital velocity $v_o = \sqrt{g_h\,(R + h)}$

**(vii) Define power and write its formula.**

**Ans** Rate of doing work is called **power**.

$$P = \frac{W}{t}$$

**(viii) What is meant by the efficiency of a system?**

**Ans** Efficiency of a system is the ratio of required form of energy obtained from a system as output to the total energy given to it as input.

$$\text{Thus, Efficiency} = \frac{\text{required form of output}}{\text{total input energy}}$$

**4. Write short answers to any FIVE (5) questions: (10)**

**(i) Why strain has no unit? Give reason.**

**Ans** $$\text{Tensile strain} = \frac{\text{change in length}}{\text{original length}}$$

Strain has no units as it is simply a ratio between two similar quantities.

**(ii) Define elastic limit.**

**Ans** It is a limit within which a body recovers its original length, volume or shape after the deforming force is removed. When a stress crosses this limit, called the elastic limit, a body is permanently deformed and is unable to restore its original state after the stress is removed.

**(iii) Write down the formula of pressure and strain.**

**Ans** Pressure $P = \frac{\text{Force}}{\text{Area}}$

or $P = \frac{F}{A}$

**Strain:**

$$\text{Tensile strain} = \frac{\text{change in length}}{\text{original length}}$$

**(iv) Define latent heat of fusion.**

**Ans** Heat energy required to change unit mass of a substance from solid to liquid state at its melting point

without change in its temperature is called its latent heat of fusion.

**(v) What is meant by internal energy?**

**Ans** The sum of kinetic energy and potential energy associated with the atoms, molecules and particles of a body is called its internal energy.

**(vi) What is the effect of temperature on evaporation?**

**Ans** **Temperature:**

Why wet clothes dry up more quickly in summer than in winter? At higher temperature, more molecules of a liquid are moving with high velocities. Thus, more molecules escape from its surface. Thus, evaporation is faster at high temperature than at low temperature.

**(vii) How does heat reach us from Sun?**

**Ans** Our Sun is the major source of heat energy. But how does this heat energy reach the Earth? It reaches us neither by conduction nor by convection, because the space between the Sun and the Earth's atmosphere is empty. There is a third mode called radiation by which heat travels from one place to another. It is through radiation that heat reaches us from the Sun.

**(viii) Why does land breeze blow in the night?**

**Ans** At night, the land cools faster than the sea. Therefore, air above the sea is warmer, rises up and the cold air from the land begins to move towards the sea. It is called land breeze.

(Part-II)

**Note: Attempt any TWO (2) questions.**

**Q.5.(a) State Newton's first law of motion and explain with the help of two examples. (4)**

**Ans Newton's Laws of Motion:**

Newton was the first to formulate the laws of motion known as Newton's laws of motion.

**Newton's First Law of Motion:**

First law of motion deals with bodies which are either at rest or moving with uniform speed in a straight line. According to Newton's first law of motion, a body at rest remains at rest provided no net force acts on it. This part of the law is true as we observe that objects do not move by themselves unless someone moves them. For example, a book lying on a table remains at rest as long as no net force acts on it.

Similarly, a moving object does not stop moving by itself. A ball rolled on a rough ground stops earlier than that rolled on a smooth ground. It is because rough surfaces offer greater friction. If there is no force to oppose the motion of a body, the moving body will never stop. Thus Newton's first law of motion states that:

A body continues its state of rest or of uniform motion in a straight line provided no net force acts on it.

Since Newton's first law of motion deals with the inertial property of matter, therefore, Newton's first law of motion is also known as **law of inertia**.

We have observed that the passengers standing in a bus fall forward when its driver applies brakes suddenly. It

is because the upper parts of their bodies tend to continue their motion, while lower parts of their bodies in contact with the bus stop with it. Hence, they fall forward.

**(b) A train starts from rest with an acceleration of 0.5 $ms^{-2}$. Find its speed in km $h^{-1}$, when it has moved through 100 m? (5)**

**Ans**

Initial velocity = $v_i = 0$

Acceleration = $a = 0.5\ ms^{-2}$

$S = 100\ m$

Final velocity = $v_f = ?$

Formula: $2aS = v_f^2 - v_i^2$

$2 \times 0.5 \times 100 = v_f^2 - 0$

$100 = v_f^2$

$v_f^2 = 100$ or

$v_f = 10\ ms^{-1}$

$$v_f = \frac{10 \times 3600}{1000} = \frac{36000}{1000} = 36\ kmh^{-1}$$

$\boxed{v_f = 36\ kmh^{-1}}$

**Q.6.(a) Define potential energy, give an example and derive its equation. (4)**

**Ans** **Potential Energy:**

Often a body has the ability to do work although it is at rest. For example, an apple on a tree is capable to do work as it falls. Thus, it possesses energy due to its position. The kind of energy which a body possesses due to its position is called its potential energy.

The energy possessed by a body due to its position is known as its potential energy.

Stored water possesses potential energy due to its height. A hammer raised up to some height has the ability to do work because it possesses potential energy. A stretched bow has potential energy due to its stretched position. When released, the stored energy of the bow pushes the arrow out of it. The energy present in the stretched bow is called elastic potential energy.

The potential energy possessed by a hammer is due to its height. The energy present in a body due to its height is called gravitational potential energy.

Let a body of mass m be raised up through height h from the ground. The body will acquire potential energy equal to the work done in lifting it to height h.

Thus Potential energy P.E. = F × h

= w × h

(Here weight of the body = w = mg)

$\therefore$ P.E. = w h = m g h

Thus, the potential energy possessed by the body at height h with respect to the ground is mgh and is equal to the work done in lifting it to height h.

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**(b) Find the magnitude and direction of a force, if its X-component is 12N and Y-component is 5N. (5)**

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**Ans**

$F_x = 12$ N

$F_y = 5$ N

$F = ?$

$\theta = ?$

Formula:

Magnitude $\Rightarrow$ $F = \sqrt{F_x^2 + F_y^2}$

Putting the values,

$$F = \sqrt{(12)^2 + (5)^2}$$
$$F = \sqrt{144 + 25}$$
$$F = \sqrt{169}$$
$$F = 13 \text{ N}$$

The direction of force F with x-axis is given by:

$$\tan\theta = \frac{F_y}{F_x}$$
$$\theta = \tan^{-1}\frac{F_y}{F_x}$$
$$\theta = \tan^{-1}\frac{5}{12}$$
$$\theta = \tan^{-1} 0.417$$
$$\boxed{\theta = 22.6^\circ}$$

13 N Force making 22.6° with x-axis

**Q.7.(a) State Pascal's law and explain hydraulic press. (4)**

**Ans** **Pascal's Law:**

An external force applied on the surface of a liquid increases the liquid pressure at the surface of the liquid. This increase in liquid pressure is transmitted equally in all directions and to the walls of the container in which it is filled. This result is called Pascal's law which is stated as:

Pressure, applied at any point of a liquid enclosed in a container, is transmitted without loss to all other parts of the liquid.

**Hydraulic Press:**

Hydraulic press is a machine which works on Pascal's law. It consists of two cylinders of different cross-sectional areas as shown in figure. They are fitted with pistons of cross-sectional areas a and A. The object to be compressed is placed over the piston of large cross-sectional area A. The force $F_1$ is applied on the piston of

small cross-sectional area a. The pressure P produced by small piston is transmitted equally to the large piston and a force $F_2$ acts on A which is much larger than $F_1$.

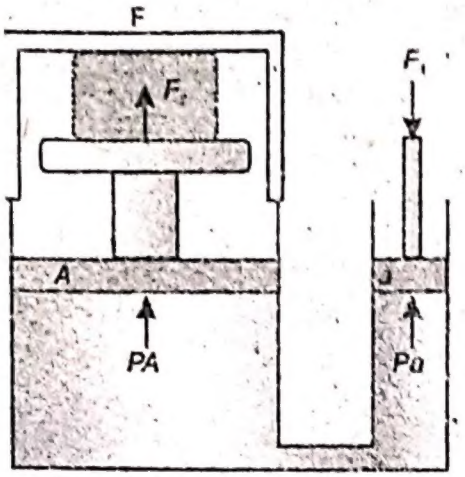


**Fig. A hydraulic press.**

Pressure on piston of small area a is given by

$$P = \frac{F_1}{a}$$

Apply Pascal's law, the pressure on large piston of area A will be the same as on small piston.

$$\therefore \quad P = \frac{F_2}{A}$$

Comparing the above equations, we get

$$\frac{F_2}{A} = \frac{F_1}{a}$$

$$\therefore \quad F_2 = A \times \frac{F_1}{a}$$

$$\text{or} \quad F_2 = F_1 \times \frac{A}{a}$$

Since the ratio $\frac{A}{a}$ is greater than 1, hence the force $F_2$ that acts on the larger piston is greater than the force $F_1$ acting on the smaller piston. Hydraulic systems working in this way are known as force multipliers.

(b) **Calculate the increase in the length of an aluminium bar 2 m long when heated from 0°C to 20°C. The thermal coefficient of linear expansion of aluminium is $2.5 \times 10^{-5}\ K^{-1}$.** **(5)**

**Ans**

$L_o = 2\ m$

$t_o = 0°C$

$t = 20°C$

$T_o = 0 + 273 = 273K$

$T = 20 + 273 = 293K$

$\Delta T = T - T_o$

$= 293 - 273 = 20K$

$\alpha = 2.5 \times 10^{-5}\ K^{-1}$

Since $L = L_o (1 + \alpha \Delta T)$

Putting the values,

$= 2m \times (1 + 2.5 \times 10^{-5} K^{-1} \times 20\ K)$

$= 2m\ (1.0005)$

$L = 2.001\ m$

Change in length $= \Delta L = L - L_o$

$\Delta L = 2.001 - 2$

$\Delta L = 0.001\ m = 0.1\ cm$

$\boxed{\Delta L = 0.1\ cm}$